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NOTES ON THE HERPETOLOGY OF JAMAICA.

BY THOMAS BARBOUR.

WITH TWO PLATES.

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No. 15. — *Notes on the Herpetology of Jamaica.*

By THOMAS BARBOUR.

INTRODUCTION.

ON the return from a trip to South America the writer stayed somewhat more than a month (March–April, 1909) in Jamaica. The opportunity was taken for collecting a considerable series of reptiles and amphibians, and as great changes have taken place, and are still taking place, affecting the abundance of many species it seems desirable to prepare the following outline of the Herpetology of the island. The introduction of the mongoose (*Herpestes griseus* E. Geoff.) has caused the almost complete extinction of many species which were once abundant, and has in some ways radically changed the facies of the fauna.

In the back country lizards are rarely met with, and it is only in the vicinities of villages and towns, where they are more or less protected, that one may obtain satisfactory series of many species. The true ground-inhabiting forms have, of course, suffered most, so that lizards of the genera *Ameiva*, *Mabuia*, and *Celestus* are now scarce and difficult to obtain. This is all the more unfortunate because the members of the last-named genus were particularly interesting, local in distribution, retiring in their habits, and even, before the introduction of the mongoose, rare in collections.

Snakes have suffered perhaps more than lizards. The general opinion in Jamaica is that the *Boa*, *Epicrates*, as well as the large *Iguana*, are now almost extinct on the main island, though they still occur on some of the near-by outlying islets. As for other snakes, the racers are now scarce and difficult to obtain, while the burrowing snakes are, owing to their habits, of uncertain occurrence. There is no reason to suppose, however, that their abundance has been affected by the spread of the mongoose.

The amphibians are quite plentiful. The large tree frogs may be heard almost any night or during showers in localities slightly above the level of the sea. I have never heard any near the sea-coast towns. The *Hylas* generally spend most of their time hiding in the clumps of what

the natives call "wild pines" (Bromeliaceae), which are epiphytic on many species of Jamaican trees.

Fresh-water turtles are not uncommon in certain localities, though perhaps, from the fact that they are eagerly sought after by the negroes, they are shy and hard to obtain.

Mention of the sea turtles has been omitted because there is nothing in their habits or distribution of particular interest. Generally speaking, all the species are becoming scarcer about the islands. Turtlers from Kingston now scour the coast of Central America, travelling back and forth in small almost open schooners. The Green turtles are sent to market in London, while the shell of the Hawksbill is prepared to some extent in Jamaica.

Under the separate discussion of the various species of lizards a considerable number of notes on the local distribution of each have been included. The ranges of many forms are surprisingly restricted, and it is very unusual to find the same species of lizard the most common one in any two localities, which are separated even by comparatively short distance. Notes made on species identified on a number of trips through the island in various directions, as well as specimens actually collected in different localities, serve to bring out this point.

I have drawn much valuable aid from Stejneger's "Herpetology of Porto Rico" (Ann. Rept. U. S. Nat. Mus. for 1902, 1904, p. 549-724, 1 pl.), as well as from Dr. Stejneger himself.

I desire to thank my friend Dr. J. L. Bremer for his assistance in making the collections.

I have used the specimens and valuable field notes of Mr. A. E. Wight, and also other material in the Museum from various sources.

LITERATURE.

There have been but comparatively few works which dealt with the herpetologic fauna of Jamaica in any fulness. Many of the species were described in scattered publications, and these may be easily referred to from the citations of original descriptions. In 1851, however, Philip Henry Gosse published his classic, "A Naturalist's Sojourn in Jamaica." This charming book contains many references, which, while they throw comparatively little light on the subject of the local distribution of the various reptiles, still have a great value in showing the abundance of many species half a century ago, as compared with their abundance at the present time. Under each species Gosse's notes have

been added where they now seem pertinent to the subject. During the time that Dr. J. E. Duerden had charge of the collections of the Institute of Jamaica he published a list of the lizards of the island in a Kingston newspaper called "The Daily Gleaner." This appeared on July 18, 1896, and contained remarks on twenty-three species mostly in the collections preserved in the Institute museum. These specimens were nearly all destroyed in the Kingston earthquake, as were also the newspaper files in the "Gleaner" office. Duerden's notes are valuable and are incorporated here from transcriptions taken from a clipping in a scrap book in the Institute library.

Besides the publications of Gossé and Duerden, Mr. Samuel Garman in 1887 contributed to the Bulletin of the Essex Institute in Salem a short series of important studies on West Indian reptiles and amphibians. Among these notices of Jamaican species occur. Prof. E. D. Cope in 1863 and again in 1894 characterized new Jamaican species in the Proceedings of the Academy of Natural Sciences of Philadelphia. The latter paper is an account of material collected by the West Indian Expedition of the University of Pennsylvania during part of 1890 and 1891. Only nine species were mentioned (p. 437-441) as taken in Jamaica.

GEOGRAPHICAL RELATIONSHIPS OF THE JAMAICAN FAUNA.

In analyzing the make up of the Jamaican herpetological fauna, we find that out of a total of thirty-four species the following twenty-five species are peculiar to the island.

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| 1. <i>Eleutherodactylus luteolus</i> (Gosse). | 12. <i>Xiphocercus valenciennesii</i> (Dum. & Bibr.), monotypic genus peculiar to Jamaica. |
| 2. <i>Eleutherodactylus jamaicensis</i> Barbour. | 13. <i>Anolis garmanii</i> Stejneger. |
| 3. <i>Hyla brunnea</i> Gosse. | 14. <i>Anolis lineatopus</i> Gray. |
| 4. <i>Hyla lichenata</i> (Gosse). | 15. <i>Anolis iodurus</i> Gosse. |
| 5. <i>Sphaerodactylus richardsonii</i> Gray. | 16. <i>Anolis opalius</i> Gosse. |
| 6. <i>Sphaerodactylus goniorhynchus</i> Cope. | 17. <i>Anolis grahamii</i> Gray. |
| 7. <i>Sphaerodactylus oxyrhinus</i> Gosse. | 18. <i>Celestus occiduus</i> (Shaw). |
| 8. <i>Sphaerodactylus gilvitorques</i> Cope. | 19. <i>Celestus crusculus</i> (Garman). |
| 9. <i>Sphaerodactylus argus</i> Gosse. | 20. <i>Celestus impressus</i> Cope. |
| 10. <i>Sphaerodactylus daenicolor</i> Barbour. | 21. <i>Ameiva dorsalis</i> Gray. |
| 11. <i>Cyclura lophoma</i> Gosse. | 22. <i>Mabuia sloanii</i> (Daudin). |
| | 23. <i>Epicrates subflavus</i> Stejneger. |
| | 24. <i>Leimadophis ater</i> (Gosse). |
| | 25. <i>Leimadophis callilaemus</i> (Gosse) |

Nine species remain to be mentioned. Of these, two have been artificially introduced. They are *Bufo marinus* (Linné) and *Eleutherodactylus martinicensis* (Peters). Besides these it is very probable that *Gonatotodes alboocularis* (Dum. & Bibr.) has spread accidentally from Cuba. The other gecko *Aristelliger præsignis* (Hallowell), which is not confined to the island, should probably be included in the list of peculiar species; the species described from the islands off the Central American coast is probably distinct, the ones on the Caymans were possibly carried there by the turtling schooners. *Anolis sagrae* Dum. & Bibr. and *Typhlops lumbricalis* (Linné) have a wide range through the West Indian region and their distribution is hard to explain. As for *Tropidophis maculata* (Bibron) I have refrained from defining its range. The Museum has specimens from Haiti which are the same as the Jamaican; we have, however, no Cuban examples, so that no evidence is available as to the similarity of these with Jamaican specimens. Regarding the presence of the fresh-water turtle *Pseudemys palustris* (Gmelin) and the crocodile *Crocodilus americanus* Laurenti there is nothing especially noteworthy. The latter probably reached the islands by swimming and may do so still occasionally, for crocodiles often get far out to sea. The turtle, however, has doubtless been long established, and more material will very probably prove the existence of island races evolved through isolation.

Thus, in conclusion, we may say that the island has twenty-five peculiar species.

The derivation of the species is in most cases evident, and falls into two groups, those which have come through the Lesser Antillean chain from northeastern South America, and those which have come from directly west. Dr. Stejneger in his careful résumé of the origin of the fauna of Porto Rico in his Herpetology of that island has shown that there the first-mentioned group is strongly predominant. This is to be expected from the geographical position of that island. In Jamaica the fauna is almost wholly composed of genera or groups of species as *Eleutherodactylus*, *Celestus* (derived from the Central American *Diploglossi*), *Mabuia*, *Epicrates*, which have reached the Greater Antilles from Central America. As in Porto Rico the *Sphaerodactyli* and *Anoles* seem also intimately related to forms from the West, and the single *Ameiva* and the *Typhlops* suggest very strongly Lesser Antillean affinities. The two species of *Leimadophis* are of a genus characteristically Antillean and which doubtless developed on the once existing land mass almost continental in size. They suggest the joining of Jamaica to Antillea as other species do the connection with Central America. A marked diver-

gence from the characteristic Greater Antillean fauna is the absence of *Bufo* and *Amphisbaena*. On the other hand, the island shares with San Domingo the peculiar genus *Aristelliger*. The autogenus *Xiphocercus* is generically separable from *Anolis*, from which it has been derived.

A peculiarity of the fauna of Jamaica is the fact that while its proximity to Cuba is practically the same as its distance from Haiti, the evident relationship of the island's fauna with that of Haiti is well marked, while with Cuba it has in common only species which range widely through the West Indian region. Now a possible explanation of this offers itself when we examine a contour map of the Caribbean Sea. One of these was published as Fig. 57 in Mr. Alexander Agassiz's "Three Cruises of the Blake" (Bulletin of the Museum of Comparative Zoölogy, 1888, 14). Mr. Agassiz showed here that the Bartlett Deep, of over 3000 fathoms, extends between Cuba and Jamaica — doubtless a cleft of very ancient origin. The depth of water, however, between the great southern arm of Haiti and Jamaica is only from 500 to 800 fathoms. There is, it is true, a hole of a depth greater than this south of the Formigas Bank. This, however, is very limited in area, and does not fundamentally affect the condition of affairs. The water between Jamaica and the Mosquito Coast of Central America is, much of it, extremely shallow, mostly 100 fathoms or less; though between the Pedro Bank and the Rosalind Bank there is a narrow stretch of water of about 500 fathoms depth.

Hydrographically, then, Jamaica is intimately related with both Central America and Haiti, and it seems probable that Lesser Antillean species and Central American species have come through a land connection which had nothing to do with Cuba. This would account, for instance, for the presence of *Aristelliger* in Haiti and Jamaica. The early separation of Jamaica from the mainland and from Haiti would account for the absence of types having such a distribution as *Bufo* and *Amphisbaena*; which may easily have reached Haiti from the mainland of Central America by way of Cuba. For another connection must have existed between Cuba and the upper peninsula of Haiti after the separation of Jamaica from Haiti, and may we not suppose that the separation took place before the migration of *Bufo* or *Amphisbaena* had extended far enough to have reached Jamaica before it was separated?

That the question is far more complex than the suggestions contained in the previous paragraphs would indicate is undoubted. Wallace, in his "Geographical Distribution of Animals" (London, 1876, 2, p. 81), says: "The West Indian Islands have been long isolated and have varied much

in extent. Originally, they probably formed part of Central America, and may have been united with Yucatan and Honduras in one extensive tropical land. But their separation from the continent took place at a remote period, and they have since been broken up into numerous islands, which have probably undergone much submergence in recent times. This has led to that poverty of the higher forms of life, combined with the remarkable speciality, which now characterizes them; while their fauna still preserves a sufficient resemblance to that of Central America to indicate its origin." Masterly as is the above résumé of the status of conditions in the region under discussion, we cannot but doubt that Dr. Wallace would have written somewhat differently had he penned these lines a quarter of a century later. Probably his "West Indian Islands" refer to the Greater Antilles only, and even so, we now know, as already stated, that throughout almost all of these there are two elements in the fauna, Central American and Northeastern South American, which have come to Cuba, Jamaica, Haiti, and Porto Rico by a land connection stretching westward and southeastward.

Another view resting solely on geological or physiographical evidences is that presented by Dr. R. T. Hill, who conducted investigations on the geographic relations of the West Indies under the auspices of Mr. Agassiz. In an article published in the "National Geographic Magazine" (May, 1896, 7, p. 181), he concludes with these words: "The Greater Antilles lie along the line of east-west corrugations and apparently represent nodes of greater elevation whereby the surfaces of these islands were projected above the waters as islands, which have persisted without continental connection or union with each other since their origin."

If we accept Mr. Hill's conclusions as he has summed them up in the sentences quoted, it is impossible to account for a West Indian flora and fauna except by riding to death again the old theory of "flotsam and jetsam." Ocean currents and prevailing winds could never have carried Central American types to any of the islands, as they work strongly in an opposing direction. This alone serves to prove the utter impossibility of Hill's conclusion. Even were winds and currents favoring, we know now that the number of types which will withstand a long submersion in sea water is vastly smaller than was once supposed when it was thought that reptiles, amphibians, land molluses, and in fact almost all orders of animals were carried hither and thither throughout the oceanic areas. This question has been most convincingly discussed by Scharff, Beddard, Semper, and others.

Mr. Agassiz has expressed an opinion on this series of relationships in

his chapters in "The Three Cruises of the Blake" entitled "American and West Indian Fauna and Flora," and "Permanence of Continents and Oceanic Basins." The following (*loc. cit.*, 14, p. 111) is pertinent:

"At the western end of the Caribbean Sea the hundred-fathom line forms a gigantic bank off the Mosquito coast, extending over one third the distance from the mainland to the island of Jamaica. The Rosalind, Pedro, and a few other smaller banks, limited by the same line, denote the position of more or less important islands which may have once existed between the Mosquito coast and Jamaica. On examining the five-hundred-fathom line, we thus find that Jamaica is only the northern spit of a gigantic promontory, which perhaps once stretched toward Hayti from the mainland, reaching from Costa Rica to the northern part of the Mosquito coast. There is left but a comparatively narrow passage between this promontory and the five-hundred-fathom line which encircles Hayti, Porto Rico, and the Virgin Islands in one gigantic island.

"The passage between Cuba and Jamaica has a depth of over three thousand fathoms, and that between Hayti and Cuba is not less than eight hundred and seventy-three fathoms in depth."

Referring to the same subject, Mr. Agassiz writes (p. 112-113):

"At the time of this connection, if it existed, the Caribbean Sea was connected with the Atlantic only by a narrow passage of a few miles in width between St. Lucia and Martinique, by one somewhat wider and slightly deeper between Martinique and Dominica, by another between Sombrero and the Virgin Islands, and by a comparatively narrow passage between Jamaica and Hayti. The hundred-fathom line connects the Bahamas with the north-eastern end of Cuba; the five-hundred-fathom line unites them not only with Cuba, but also with Florida. The Caribbean Sea, therefore, must have been a gulf of the Pacific, or have been connected with it by wide passages, of which we find the traces in the tertiary and cretaceous deposits of the Isthmus of Darien, of Panama, and of Nicaragua. Central America and northern South America at that time must have been a series of large islands, with passages leading between them from the Pacific into the Caribbean."

And on page 113:—

"While undoubtedly soundings indicate clearly the nature of the submarine topography, it by no means follows that this ancient land connection did exist as has been sketched above. At the time when the larger West India Islands were formed and elevated above the level of the sea, they may have been raised as one gigantic submarine plateau of irregular

shape, in which were included the Bahamas, Florida, Cuba, San Domingo, Porto Rico, and the Virgin Islands."

Mr. Agassiz, however (p. 116), finally tends toward opinions very similar to those of Hill:

"The deep soundings (over three thousand fathoms) developed by the 'Blake' south of Cuba, between that island and Yucatan and Jamaica do not lend much support to the theory of an Antillean continent as mapped out by Wallace, nor is it probable that this continent had a much greater extension in former times than now, judging from the depths found on both sides of the West India Islands. This would all tend to prove the want of close connection between the West India Islands and the adjoining continent. It leads us to look, for the origin of the fauna and flora of those islands, to causes similar to those which have acted upon oceanic islands. The proximity of these islands to a great continent has, however, intensified the efficiency of these causes."

If we grant for the sake of argument that the Greater Antilles, like all Oceanic Islands, have received their fauna fortuitously, we must then explain the regularity and consistency with which the fauna has spread from two directions to populate such a great number of separate islands, with and against the prevailing wind and current. We find in the Lesser Antilles that the fauna is of almost purely Northwest South American origin; as we pass thence to St. Thomas and to Porto Rico we note, as Stejneger has shown, the very evident two-fold origin already mentioned. Then in Jamaica and Cuba the balance is in the opposite direction—types of Central American origin predominate. The ancestry of *Cricosaura*, *Amphisbæna*, *Bufo*, and other forms prove that migration to these two islands took place along independent land bridges. The fact that the Jamaican coney belongs to a different section of the genus (*Capromys*) similar to the Haitian and different from the Cuban species, and that *Solenodon* occurs in Cuba and Haiti and not now or so far as we know ever in Jamaica, proves or helps to prove the independent connection with Haiti of both Cuba and Jamaica. Finally, in favor of the "bridge theory" Dr. Stejneger in a recent letter writes: "Whatever the mountain structure may show, certainly the geographical distribution of the animals shows that the Greater Antilles have been part of a continent at some time."

That Dr. Stejneger's opinion represents views which are gaining constantly in credence among present-day students of zoögeography there can be no doubt. Dr. R. F. Scharff in his "History of the European Fauna" (London, 1899) cites many experiments to show that land snails

are more easily killed by emersion in salt water than many students in the past have supposed. Slugs when in the act of crawling on twigs drop off immediately when subjected to a slight spray of sea water. Scharff (*loc. cit.*, p. 17) continues: "If we supposed, therefore, that a slug had successfully reached the sea, transported on a tree-trunk, the moisture would tend to lure it forth from its hiding-place under the bark, whilst the mere spray would prove fatal to its existence." He adds that species of snails and slugs which lead an underground existence would be much less likely to get started on these sea voyages. The suggestion advanced by Darwin that young snails just hatched might adhere to the feet of birds roosting on the ground and then be transported, seems improbable. Dr. Scharff in his "European Animals: Their Geological History and Geographical Distribution" (New York, 1907) states that in a letter Dr. Knud Andersen of Copenhagen has informed him that he has examined the legs and wings of many thousands of migratory birds, "that their legs were clean; and no seeds or other objects were found adhering to their feathers, beaks or feet. It has also been proved that birds migrate on empty stomachs."

There is also good authority for the statement that amphibians and earthworms very rarely or never occur on the two shores of a stretch of sea except when there is evidence showing the former existence of a land connection.

To quote again from Scharff (*loc. cit.*, p. 18-20): "The formerly prevalent belief of the permanence of ocean basins has been shaken by the utterances of some of the greatest geologists of our day, whilst many positively assert that what is now deep sea of more than 1000 fathoms was dry land within comparatively recent geological epochs. Thus the Azores are classed by Darwin and Wallace among the oceanic islands — that is to say, among such as have received their fauna and flora by flotsam and jetsam. But Professor Neumayr believes, on geological grounds, that the Old and New Worlds were connected by a land-bridge during Tertiary times right across the Atlantic, and that the Canary Islands, Madeira, and Azores . . . are the last remnants of this continent. This meets with the entire approbation of Dr. von Ihering, who has recently re-investigated the subject from a faunistic point of view. . . . Take another instance of one of Wallace's most typical oceanic islands, the Galapagos Group. Their fauna and flora have recently been most thoroughly re-explored by an American expedition, the result of which, according to Dr. Baur, goes to show that these islands must have formed part of the mainland of South America at no distant date. The fauna

and flora are therefore to be regarded as having reached them in the normal mode, viz., by migration on land. According to Mr. Beddard . . . it is difficult to see how earthworms could be transported across the sea. Floating tree-trunks have been observed far out at sea, but unless the water remained absolutely calm during the long period necessary for the drifting by currents, so that no splashing occurred, the worms would probably be killed. Yet earthworms do occur on oceanic islands. It is indeed quite possible that our views with regard to the origin of the remainder of the Pacific Islands may change very materially, and once more revert to what Dr. Gould expressed nearly fifty years ago in the following words: 'From a consideration of the land-shells on the Pacific Islands, it seems possible to draw some fair inferences as to the relations of the lands which once occupied the area of the Pacific Ocean, and whose mountain peaks evidently now indicate or constitute the islands with which it is now studded.' Indeed Dr. von Ihering goes so far as to positively state that in his opinion the Polynesian Islands are not volcanic eruptions of the sea floor, which being without life were successively peopled from Australia and the neighboring islands, but the remains of a great Pacific continent, which was in early mesozoic times connected with other continental land masses. . . .'

Scharff continues (p. 21): "Amphibians are affected in the same manner by sea-water as slugs are. The accidental transportal of an amphibian from the mainland to an island is therefore almost inconceivable. And the presence of frogs, toads, and newts in the British Islands, in Corsica and Sardinia, indicates, if nothing else did, that all these islands were at no distant date united with the continent of Europe."

All these remarks and quotations tend to show that the belief held by the writer is not an unusual one, for certainly the fauna of the Greater Antilles possess vastly more species than do either of the islands previously mentioned, which are among those now generally conceded to be forms which will not survive transportal by the theory of flotsam and jetsam which was so strongly urged by both Darwin and Wallace. And without criticising the unassailable positions which both these men hold as founders of the science of zoögeography, we must agree with Scharff and other more modern students that their theories regarding the origin of the faunae of islands require revision in the light of new data which have come to hand from recent explorations.

Regarding the continental aspect of the faunae of various West Indian islands, one type remains to be mentioned which from its peculiar characteristics renders quite inconceivable its being carried about on floating

objects. *Peripatus* is one of the most delicate of known organisms. Dr. Grabham, a well-known field naturalist, long resident in Kingston, Jamaica, told me that with the greatest care he had never been able to bring a living *Peripatus* from Bath to Kingston in Jamaica, a distance of thirty-five or forty miles, and my experience has been exactly the same. Last winter it was found absolutely impossible to keep alive at all any of the hundred-odd specimens which were taken in the vicinity of Bath. On the return from a day's collecting many dead specimens of *Peripatus* were always found in the receptacle in which they were carried, which was filled with the natural earth and moss taken from the spot where the creatures were found. Aside from this, the fact that the creatures are killed in a remarkably short space of time in alcohol, weak formalin, or by an emersion in hot water far below the boiling point, tends to substantiate this view whatever may be true with other species of the group. Now we know that *Peripatus* occurs not only in Jamaica, where there are two species, but also on the island of Trinidad, on Dominica, on St. Thomas, Antigua, and Porto Rico. The species on Trinidad bears a close similarity to South American forms. The species in the Lesser Antilles and in Porto Rico are very closely related to one another. In fact, Bouvier prefers to consider them sub-species of the long known *Peripatus dominicae*. The Jamaican forms, on the other hand, he groups more with the Central American species, which substantiates the evidence presented by the distribution of the reptiles and amphibians. Again Bouvier in his "Monographie des Onychophores" (Ann. Sci. Nat. Zool., 1907, ser. 9, 2, p. 72, 73) gives us in succinct form his ideas regarding the distribution of recent Onychophora. From his "*Peripatides primitifs*" he derives, first of all, two great groups, the Indo-Malayan forms and his "*Peripatus andicoles*." These groups he shows to differ fundamentally in structure and to represent an extremely early separation. From the latter group he derives directly "*Peripatus caraibes*" and lastly from these all the African forms. It may be urged that the connections by which *Peripatus* reached Antillea have been very ancient indeed, and had nothing to do with more recent ones used by modern types. In view of the fact that a great part of the islands has been under water in recent geologic times it is quite possible that *Peripatus* utilized the same connections over which more specialized forms have come, so that they may be of importance when rather recent migrations are considered. There seems no reason to believe that there have been several successive approximations of Antillea to the adjacent mainlands.

Calvert, in a recent paper on the "Odonate Fauna of Mexico and Cen-

tral America" (Proc. Acad. Nat. Sci. Phila., 1908, 60), says that the actual distribution of the Odonata is determined by the conditions under which their aquatic larvae are able to exist, and that our present information refers to the appearance of the imago in certain localities, and the summary herewith presented rests on the unproven assumption that the adults do not wander far from the waters in which they have passed their earlier stages or in which their offspring are capable of surviving. There are about 91 species of Odonata known in the West Indies; 56 of these, or 61½ per cent, also occur in Central America. The number of species common to both regions is likely to be increased by future explorations. But making use of the present figures, it is very surprising that only 61½ per cent of the West Indian Odonata are found in Mexico and Central America, seeing that the prevalent winds on the east coast of the mainland are easterly. With such insects as the Odonata one might expect winds to play an important part as means of dispersal.

Scharff quotes Mr. C. T. Simpson, who has had experience of oceanic dispersal in the West Indian region. He has examined floating rafts of bamboo, which would be suitable in the transportal of invertebrates, nevertheless he does not attach much importance to this means of distribution. "The fact," he remarks, "that the operculates (operculate land-shells) form so large a proportion of the Antillean land-snail fauna, that a majority of the genera are found on two or more of the islands and the mainland, while nearly every species is absolutely restricted to a single island, appears to me to be very strong testimony in favour of a former general land connection."

Since the previous notes on the zoögeography were written, Dr. Scharff's paper, "On an Early Tertiary Land-Connection between North and South America" (Amer. Nat., 1909, 43, p. 513-531), has been received. While this does not deal directly with the West Indies, nevertheless it contains references and statements which leave no room for doubt but that Dr. Scharff does not question the existence of an Antillean continent. His quotation from Ortmann (*loc. cit.*, p. 518) is pertinent: "In place of the present Southern continent he thinks that towards the end of Mesozoic times, there existed the old Brazilian land (Archiplata), an Antillean continent (including the West Indies and Venezuela) and also the Chilean coast range." Again, in discussing Arldt's views, Dr. Scharff says: "His conception of an extensive land having once flourished to the west of Central America, while the latter was largely submerged, is not altogether new. In alluding to the east-westward trend of the Antillean Cordillera and its abrupt termination on the Pacific coast of Guatemala, Professor

Suess makes a suggestion as to its former westward prolongation. Precisely at the point, he says, when the arcuate continuation of this chain might be expected to meet the principal chains of South America, lie the volcanic Galapagos Islands."

Dr. Scharff (*loc. cit.*, p. 523) uses *Peripatus* to illustrate an archaic group having a remarkable discontinuous distribution.

The writer has no suggestion to offer on the age of the various Antillean connections assumed. Antillea must have persisted until Central America had some such shape as it has at present. For Cretaceous connections such as suggested by Arldt connecting northern South America with western Mexico, would not explain present distributions and would, of course, be too early to have bearing on many existing types. One fact can be clearly proved by the land animals of the islands, namely, that land connections have existed in spite of the claim of many geologists of the "permanence of the continents in their present form," and of others who with Dr. Hill believe that the Antilles have always existed in their present form. Fortuitous distribution has played practically no part in providing the Antilles with a fauna.

VERTICAL DISTRIBUTION.

The hills of Jamaica rise at Blue Mountain Peak to a height of 7423 feet, and in several places are over 5000 feet. Nothing, however, seems especially noteworthy regarding the vertical distribution of species. A considerable number of notes bearing on this topic are introduced in their appropriate places.

For the benefit of lay visitors to the island it may be said that not a single venomous reptile occurs on the island, in spite of the statements of the natives.

SPECIES DOUBTFULLY RECORDED.

The following forms reported as from Jamaica are without doubt wrongly labeled as to locality:

Phyllodactylus ventralis O'Shaughnessy. The type of this gecko was said to have come from Jamaica. Boulenger questioned the accuracy of this locality in "Catalogue of Lizards," 1885, 1, p. 80. The species is a Central American one.

Diploglossus monotropis Wiegmann. A specimen of this species is in the British Museum, and served Gray as the type of his *Tiliqua jamaicensis* (Ann. Mag. Nat. Hist., 1839, ser. 1, 2, p. 293). Boulenger (*loc. cit.*,

1885, 2, p. 286) has bracketed the locality. This lizard is also Central American.

Anolis equestris Merrem. Duerden included this species in the list of Jamaican lizards already mentioned. He doubtless followed Boulenger (*loc. cit.*, 1885, 2, p. 21), where the habitat is given as "Cuba, Jamaica." As we know now, the species is confined to Cuba.

Anolis richardii Gray. This species has been reported from Jamaica on the basis of a specimen in the British Museum taken by J. Winterbottom, Esq., and which served Gray as the type of his *A. stenodactylus*, which is, according to Boulenger, synonymous with *A. richardii*. Duerden in the "Gleaner" records this species No. 12 in his list, but remarked that it was very rare, for no specimen had ever been received at the Institute of Jamaica. The supposed Jamaican example was without doubt taken in the Lesser Antilles, to which region the species is confined. A species common to, say, both Jamaica and Dominica would be absolutely foreign to what we know of the distribution of species whose ranges are accurately known and which have not been introduced artificially.

Eleutherodactylus lentus (Cope). Though Cope himself has recorded this lesser Antillean species from Jamaica, there seems to be no reason whatever to suppose that it really occurs there. It was probably *E. luteolus* (Gosse) wrongly identified.

Bufo marinus (LINNÉ).

Rana marina Linné, Syst. Nat., Ed. 10, 1758, 1, p. 211.

This species, introduced in Jamaica as in so many other West Indian Islands, is now widespread. There are examples in the collections at hand from Kingston, Mandeville, and Port Antonio. Gosse (Nat. Sojourn in Jamaica, 1851, p. 430) states that the introduction took place from Barbadoes in 1844.

Eleutherodactylus luteolus (GOSSE).

Plate 2, Fig. 2.

Litoria luteola Gosse, Nat. Sojourn in Jamaica, 1851, p. 366, pl. 7.

Hylodes luteolus Boulenger, Cat. Batr. Sal., 1882, p. 208.

This seems to be the most abundant native amphibian. Gosse has given an excellent figure for the light brown color phase, which is, I think, rather less common than a mottled slate-colored phase in which there is a distinct light vertebral line which bifurcates, sending a branch along the hinder side of the thighs. This species may be easily separated from *E. jamaicensis*, sp. nov. by the very small digital discs and by this vertebral line. The development of this frog is of interest. The eggs from thirty to thirty-five in number are laid in depressions in damp ground under stones or logs. Mr. Wight has also found these nests and writes:

“Port Antonio, Jamaica. Nov. 30. Thirty-three eggs in slight depression, damp ground. Eggs scarcely adherent. Movements of embryos visible. 168 hours later two frogs hatched. After 312 hours the whole lot had taken on the light brown color which is typical of many adults.”

The species is confined to Jamaica and seems to be generally distributed over the island. Mr. Garman collected many specimens about Kingston in 1878 (M. C. Z., No. 2044); in 1905 Major Wirt Robinson sent in a series from the same locality (M. C. Z., No. 2427). The Museum has also two specimens from Moneague (No. 2045). Among those recently obtained are many specimens from Kingston, Mandeville, and Port Antonio collected by Mr. Wight and the writer. Several Mandeville specimens measure four inches from nose to tip of outstretched hind toe, which is much larger than measurements of examples from other localities.

***Eleutherodactylus jamaicensis*, sp. nov.**

Plate 2, Fig. 1.

Types: five specimens (M. C. Z., No. 2512), taken March, 1909, at Mandeville, Jamaica, by Thomas Barbour.

Tongue narrow, extensively free and not nicked behind. Vomerine teeth in two arched series, each one beginning behind the center of one of the internal nares and almost meeting the other at the median line. (In *E. luteolus* the series are much more extensive in that they begin laterally beyond the outer limits of the choanae). Nostrils latero-dorsal, one third of the distance from tip of snout to eye. Upper eyelids much narrower than interorbital space. Tympanum rather more than one half the diameter of the eye, its distance from the latter barely one half its diameter. Discs on fingers large and conspicuous, on toes smaller. First finger shorter than second; first toe also short, reaching to second subarticular tubercle of second toe. (The first subarticular tubercle is at the very base of the toe.) Well developed subarticular tubercles throughout. Two metatarsal tubercles, the inner strong and well developed, the outer so small as to be hardly visible. No tarsal fold. The hind limb being carried forward along the body, the tarso-metatarsal articulation reaches to between the eye and the nostril.

Color rather variable. Back brown of varying shades generally darker in mid-dorsal region. Apparently always some indication of a pair of light brown dorso-lateral areas. These may be conspicuous. One specimen has a light vertebral line which does not, however, bifurcate and extend along the thighs as in *E. luteolus*. An irregular triangle of dark brown on top of head, two angles of which lie on the eyelids, while the third extends on the nape and generally merges with the dark dorsal area.

The figure was made with the aid of copious notes taken from living specimens. They have changed, however, but very slightly in spirits.

Eleutherodactylus martinicensis (PETERS).

Hylodes martinicensis Peters, Monatsber. Akad. Wiss. Berlin, 1876, p. 709, pl. 1.

The distinctness of this species from *E. auriculatus* (Cope), found in Cuba, San Domingo, and Porto Rico, has been discussed by Stejneger (Rept. U. S. Nat. Mus. for 1902, 1904, p. 583-584). During a recent visit to Washington he showed me a number of specimens from Hope Gardens near Kingston, Jamaica. These were accompanied by collector's notes, which said that the frogs had been brought to Jamaica by Lady Blake during the incumbency of her husband, Sir Henry Blake, as Governor of Jamaica. This statement seems the more probable as the species has been very widely carried from island to island among the Lesser Antilles.

I think it doubtful whether the original habitat of this species will ever be known.

Hyla brunnea GOSSE.

Gosse, Nat. Sojourn in Jamaica, 1851, p. 361.

Hitherto it has been stated by Boulenger that both *Hyla ovata* (Cope) and *Hyla dominicensis* (Tschudi) occurred in Jamaica as well as in San Domingo. An examination of the type of *H. ovata* (M. C. Z., No. 1518), as well as other examples here and in the National Museum, convinced both Dr. Stejneger and myself that this species is a synonym of *H. dominicensis*. The types of this species came from San Domingo to the Paris Museum, taken by Mr. Alex. Ricord. The Jamaican tree frogs being different from the San Domingan ones, as a very large number show, it becomes necessary to use Gosse's name for these specimens. In all examples of *Hyla brunnea* the snout is abruptly truncate in profile, with the nostril near the apex. In *H. dominicensis* the nostril is much nearer to the eye, and the snout profile is a gentle slant-curve. This species also grows half as large again as *H. brunnea*. This Jamaican tree frog has also been confounded with and recorded as *H. septentrionalis*, which is a form quite distinct and not found in Jamaica.

The young of this species show a peculiar dichromatic condition. They may be generally dark in color, *i. e.* rather like the adults; or they may be light yellow, almost transparent, amber-like, with a broad white-edged, golden metallic band between the eyes. When I first took six or seven of these, I was convinced that they represented a new species, but the large series shows that this is not the case.

Gosse, *loc. cit.*, p. 358-361, has a number of interesting notes on tree frogs, remarking on the calls so often heard at night. He says that he is informed that the frogs spend their time sitting in the small amount of water held "by the large ventricose leaves of the greater wild pines, especially that fine one, *Tillandsia lingulata*." This is quite true, and about Mandeville in an afternoon by cutting down bunches of these epiphytes and shaking them, more than thirty specimens were obtained. Mr. A. E. Wight took six examples from the wild pines near Port Antonio, and has since sent in others from Mandeville. The characteristic

harsh grating snoring of this frog is heard all over the island where wild pines are abundant, *i. e.* at a slight elevation above sea level.

As with so many other West Indian forms, it becomes more and more certain, as extensive collections from the different islands are studied, that their distribution is not so wide-spread as many of the older writers have supposed. Neither do many closely related forms generally exist on one island. This very fact now so well proven rendered the record of three closely related *Hylas* from Jamaica as obviously suspicious; and these three species typical of other islands reduce themselves to one peculiar form. It may be noted here that the citation given by Boulenger to the original description of *Hyla dominicensis* Tschudi (Batr., 1838, p. 72) refers to a *nomen nudum*. The description is on page 30.

Hyla lichenata (GOSSE).

Trachycephalus lichenatus Gosse, Nat. Sojourn in Jamaica, 1851, p. 362, pl. 7.

Unfortunately I have been unable to examine a single specimen of this most strange creature. Neither this Museum nor the United States National Museum has a single example, and I have learned recently that the specimens which Cope reported were in the Museum of Amherst College have been discarded as too poorly preserved. Cope also recorded (Proc. Acad. Nat. Sci., Phila., 1863, p. 46-47) a specimen in the Smithsonian Collection, which has been lost. The species *Hyla anochlorus* (Gosse), redescribed by Cope (*loc. cit.*), was doubtless based on sexual characters of divergence only.

The species, which seems very rare, is known from Jamaica only.

Gonatodes albogularis (DUM. & BIBR.).

Boulenger, Cat. Lizards Brit. Mus., 1885, 1, p. 59.

Gymnodactylus albogularis Dumeril et Bibron, Erp. Gén., 3, 1836, p. 415.

I have three specimens from Kingston, kindly sent me by Dr. Boulenger, who writes that Mr. C. A. Wray recently took a number in wooden houses about that town. The species must be of very local distribution, as none of the collections accessible contain specimens. The British Museum had two Jamaican specimens when the catalogue was compiled. Dr. Duerden remarked that it was very rare and that the Museum of the Institute of Jamaica had never received a single example.

Occurs in Cuba and Jamaica; like other geckos, it may prove to be of wider fortuitous distribution. Perhaps, we might almost say probably, introduced into Kingston by the direct communication with Santiago de Cuba.

Aristelliger praesignis (HALLOWELL).

Hemidactylus praesignis Hallowell Proc. Acad. Nat. Sci. Phila., 1856, p. 222.

Another species which is generally wide-spread over the island. The natives have a peculiar fear of "the croaking lizard," and it is seldom that they can be persuaded to bring it in. Mr. Wight notes that it seems to be rare. This,

however, is not the case. It is readily found when once one knows where to look for it: about the rafters of old buildings, in the wall crevices of the ruins of the many long-disused sugar factories, and in hollow trees. While hunting insects, its eggs are often found in crannies of bark, sticking to the wood and to each other in pairs. These eggs are found in the same places and are just the same size and are laid in the same way as those of *Ptychozoon* in the East Indies. Gosse (*Nat. Sojourn in Jamaica*, 1851, p. 184-185) discusses the egg laying, but there seems no reason to suppose that the period of incubation is the same as in *Ptychozoon*, where the eggs, as Annandale has shown, last over from one season and do not hatch till the next year. Good specimens are almost impossible to get. The skin of the neck and back is as delicate as damp tissue paper and tears as easily, while the tail is very frequently dropped. Fourteen specimens from near Kingston are before me. Mr. Wight's specimen is from near Port Antonio. The Museum has Jamaican specimens with no special data; also two from Cayman Brac, and three from Grand Cayman. From these two islands they were first made known in Garman's report on Maynard's collections. It would be curious if this lizard had not been found on this outlying dependency of Jamaica, when we think of the constant communication between the islands and the long-known frequency with which geckos are accidentally carried about. The type of *Aristelliger lar* Cope from Jeremie, Hayti, is nearly 14 inches long. This is five inches longer than any of our specimens of *A. praesignis*, and almost the same amount larger than the one which Boulenger had measured for the Catalogue. Series of embryos of this species were prepared for the Zoölogical Department of Harvard University and for the Embryological Department of its Medical School.

Known from Jamaica and the Cayman Islands.

***Sphaerodactylus richardsonii* GRAY.**

Gray, *Cat. Lizards Brit. Mus.*, 1845, p. 168.

Gosse, *Nat. Sojourn in Jamaica*, 1851, p. 254.

The Museum of the Jamaica Institute before its destruction contained two specimens of this rather rare gecko. A specimen in the British Museum came from Montego Bay. The only other example there, the type, is without definite locality. I have three examples, all taken about Kingston. As with the other members of this family, this lizard is probably widely spread over the island, though its shy habits and apparent scarceness make it a little known member of the fauna. It seems to haunt the crevices in old rock walls, though I was informed that an individual had been seen under the thatching of the roof of an old house. This species does not lose its tail easily. It grows to a length of nearly four inches. Gosse during his long stay on the island met with only a single example; this was near Montego Bay. Perhaps this specimen is the one now in the British Museum, though Boulenger gives no data concerning it.

It is peculiar to the island.

Sphaerodactylus goniorynchus COPE.

Cope, Proc. Acad. Nat. Sci. Phila., 1894, 1895, p. 440.

This species is not represented in any of the collections which have come to hand from Jamaica. The types were taken by the University of Pennsylvania West Indian Expedition of 1890 and 1891 at Port Antonio. There is a well-preserved example, No. 36648, in the United States National Museum.

Peculiar to Jamaica.

Sphaerodactylus oxyrhinus GOSSE.

Gosse, Ann. Mag. Nat. Hist., 1850, ser. 2, 6, p. 347.

It is very unfortunate that our collections throw no new light on the habits or distribution of this rare form. Dr. Duerden recorded, Kingston Daily Gleaner, that the Museum of the Institute of Jamaica had two specimens. A careful search failed to find them among the few reptiles still preserved there. They were probably destroyed by the earthquake or lost during the subsequent moving of the collections.

Boulenger records but one specimen in the British Museum, Gosse's type from St. Elizabeth (Cat. Liz. Brit. Mus., 1885, 1, p. 222). There is also but a single specimen in the collections here, No. 7033, without more definite locality than Jamaica.

Sphaerodactylus gilvitorques COPE.

Cope, Proc. Acad. Nat. Sci. Phila., 1861, p. 500.

This gecko has been supposed to be most uncommon. Duerden states that no specimen ever reached the Institute collection. The same may be said of Boulenger (*loc. cit.*, p. 227), who did not know the species from autopsy. Eleven examples taken while searching for *Peripatus* near Bath, in eastern Jamaica, are before me. Most of these were taken deep among the roots of banana plants, where their eggs, scattered singly in the earth or decaying vegetable matter on the ground, were also found. This little lizard seems to be a rather good burrower. Three specimens came from Mandeville in middle Jamaica; they were caught under stones. Mr. A. E. Wight took several here and three more near Port Antonio. His field notes show that these also were taken under stones. He remarks on their activity and difficulty of capture, which is rather striking. This species is sometimes called "wood slave" or "little wood slave" by the natives, though more generally by the name mentioned for *S. argus*. The name of "wood slave" is a very old one, also occasionally applied to *Mabuia sloanii*, for which the name "snake-waiting boy" is now more common. Gosse mentions the former name.

The color is fairly variable. The collar is generally very inconspicuous, while the rather elaborate arrangement of lines on the head, described by Boulenger and Cope, is not at all a constant character. Generally speaking, all are rich mahogany brown above, with rhomboidal markings in reddish brown. These may be faint,

but are almost always visible on the posterior part of the body. Below lighter, sometimes rather bluish or ashy gray, finely dotted with dark brown. The chin is often almost white with dark brown parallel lines in two series, which converge towards the middle of the back of the throat. A freshly hatched young one shows white marked rhombs and conspicuous white lines on the neck.

Found only on Jamaica, perhaps more common in higher altitudes, as in Mandeville and the hills about Bath. Though Wight's specimens came from lowlands about Port Antonio, not a single example was taken on the plain about Kingston.

Sphaerodactylus argus GOSSE.

Gosse, Ann. Mag. Nat. Hist., 1850, ser. 2, 6, p. 347; Nat. Sojourn in Jamaica, 1851, p. 76, 284.

This is the commonest member of this genus over the part of Jamaica whence it is recorded. We took sixty-four specimens about Kingston and fifteen at Mandeville, where Mr. Wight has also taken it. A few years ago Major Wirt Robinson gave two examples to the Museum, also from near Kingston. Gosse took it in western Jamaica, and the Museum has one from Moneague. From the vicinity of Bath and Port Antonio and other stations near by, it seems to be quite certainly absent. Mr. Wight also failed to find it at Port Antonio.

The series from Kingston shows that this is perhaps the most variable species in the genus. This lizard may present a uniform pepper-and-salt appearance, or the white may appear in the typical ocelli on the back and top of the head, or the ocelli on the back with elongate spots on the neck and the head, or as white vittae. The white markings may be absent on any one region and present on another, thus making possible a large number of combinations in pattern. The lower surface of the tail is usually coral red in life. The color of the embryos just before leaving the egg seems to be of one pattern only. The six white bands sometimes seen on the heads and necks of adults here are very wide and conspicuous and extend from nose to root of tail. They are rather dark edged and the ground color is uniform slaty without the finely punctulate appearance of the ground color of the adult.

For all these small geckos one must search carefully in the cracks and cranies of old walls, under loose stones, and about thatched roofs. A pile of old thatching lying on the ground is certain to contain *Sphaerodactyli* if any occur in the neighborhood. The negroes in Jamaica, who can aid one tremendously in lizard hunting, call all of the genus "pawley" lizards or water lizards. The latter name is used about Mandeville, and no explanation was obtained as to its meaning.

The species is peculiar to Jamaica.

Sphaerodactylus dacnicolor, sp. nov.

Plate 1.

Types: two specimens (M. C. Z., No. 7276) collected at Port Antonio, Jamaica, by Mr. A. E. Wight.

Snout pointed and elongate, distance from tip of nose to eye greater than

distance from latter to ear opening. Rostral large with a long median cleft. Nostril between rostral, first supralabial, one small triangular postnasal, and a moderate supranasal. The two supranasals and a small scale between them border the rostral above posteriorly. Four large supralabials to beneath center of eye. Head and body covered with small, rather prominent, tubercle-like scales, larger on snout. Mental large, like rostral, in contact with two scales posteriorly. Two large and deep, one small and deep, and one small and narrow infralabials. Scales on throat imbricate, small, rounded in outline, sometimes with a trace of a keel. On the belly the scales are smooth with a more triangular outline.

Ground color of upper surfaces grayish or slightly reddish, with scattered spots of dusky gray. Some of these are of considerable size, much larger than in *S. punctatissimus* Dum. et Bibr., or in *S. nigropunctatus* Gray. Posterior to the sacral region is a spectacle-like marking similar to that often seen in *S. lineolatus* Lichtenstein var. B. Boulenger (Cat. Liz. Brit. Mus., 1885, 1, p. 222).

Cyclura lophoma GOSSE.

Gosse, Proc. Zool. Soc. Lond., 1848, pt. 16, p. 99-104, pl. 1.

Gosse, Nat. Sojourn in Jamaica, 1851, p. 76-77.

We did not succeed in securing a specimen of the Iguana. It is reported to be still extant in the range of highlands known as the Heathshire Hills, but to be very rare. It is absent from the rest of the main island. Dr. M. Grabham, the well-informed naturalist of Kingston, to whom I am indebted for many valuable notes, tells me that a small colony still exists on Goat Island. This is a good-sized piece of land, whither happily the mougoose has not been carried and where probably the last of the iguanas and boas will be found. Goat Island lies in Portland Bight, off the south coast of Jamaica, not far from Old Harbor and the mouth of Salt River.

Until some one studies material from all the islands on which iguanas occur, so that the exact identity and distribution of each species can be made out, it is impossible even to conjecture the range of all the species. This one, to judge from descriptions only, seems to be confined to Jamaica.

Xiphocercus valenciennesii (DUM. & BIBR.).

Anolis valencienni Dumeril et Bibron, Erp. Gén., 1837, 4, p. 131.

Placopsis ocellata Gosse, Nat. Sojourn in Jamaica, 1851, p. 226-227.

This lizard, which is commonly known to the natives as "the white croaking lizard with red gills," is everywhere very uncommon. Three specimens were taken at Constant Springs, near Kingston, and one at the Castleton Botanical Gardens. The species is known to the natives in the vicinity of Spanish Town and Mandeville. From the latter locality Mr. Wight has recently sent in seven fine examples. At Bath, and at other points in the eastern part of the island, as well as at Port Antonio, it was not known to the natives, so far as I could find out. There is a specimen in the collection of the Museum, No. 6232, from Kingston. The life colors of this creature are rather attractive. It is gray or whitish

green varied with dark lines and narrow points of brown. The body is often reddish below. The dewlap is a splendid rich claret color. As one sees it clinging to the bark of a tree, the resemblance to a lichen is most striking. It is not so quick in trying to escape as most of the other forms and is ready to bite viciously. The natives consider it the most poisonous lizard on the island.

Gosse reports having seen only three specimens during his stay in Jamaica. He mentions no special locality, but page 226 of "A Naturalist's Sojourn in Jamaica" is headed "Kingston," and they probably came from there.

The species is peculiar to Jamaica.

The Jamaican Anoles resolve themselves into six species, of which five are peculiar to Jamaica. *Anolis garmanii* Stejneger is the largest, most easily identified, and the most widely distributed. *Anolis lineatopus* Gray is perhaps the most abundant lizard on the island, though its range is peculiarly circumscribed. *Anolis sagrae* Dum. et Bibr. is found sparingly and, of course, is a wide-ranging species. Three species are very closely related and extremely difficult to distinguish *inter se*, viz., *Anolis opalinus* Gosse, *A. iodurus* Gosse, *A. grahamii* Gray.

Anolis garmani STEJNEGER.

Stejneger, Amer. Nat. 1899, **33**, p. 602.

Dactyloa edwardsii Gosse, Nat. Sojourn in Jamaica, 1851, p. 76, 142-145, pl. 4.

This beautiful vivid green lizard is perhaps the most widely distributed, though by no means the most common of its genus on the island. I have before me specimens from near Kingston, Mandeville, Port Antonio, Buff Bay, and Bath, and my notes show that I observed it almost all over the island. The description given by Boulenger in his Catalogue of the lizards of the British Museum describes the colors very well. The species seems to change rather less than the others during life, though the vivid green may become a dull brown. The color of the dewlap is light orange. It is found often at the base of the leaves of palm trees, where its color protects it very well. I never saw one of these lizards within ten feet of the ground. Gosse writes that it seems to affect the higher mountain woods. It seems now, however, to be as common at lower levels. Gosse also notes that the food consists of insects and vegetable substances. My observations substantiate this statement.

This species is known only from Jamaica.

Anolis lineatopus GRAY.

Gray, Ann. Mag. Nat. Hist. 1840, **5**, p. 113.

Boulenger, Cat. Lizards Brit. Mus. 1885, **2**, p. 39-40, pl. 1, figs. 1-2.

The zebra lizard is excessively common on the coastal plain about Kingston and Spanish Town. When riding along the Constant Spring Road, it was often noted that about eight out of ten fence posts or trees passed had from one to four of these lizards upon it. They became, however, uncommon when the road passed into the woods. Continuing across the island to the north shore not a single

specimen was seen after the ridge was crossed, and at Castleton Gardens on the north side of this divide a careful search failed to reveal a single example. In the material at hand are about a hundred or more examples taken within a mile of the Constant Spring Hotel. They are equally abundant about the outskirts of Spanish Town; but at Mandeville not a single example was found.

Anolis sagrae DUM. & BIBR.

Dumeril et Bibron, *Erp. Gén.*, 1837, 4, p. 149.

Apparently rare. There are three specimens in the United States National Museum from Jamaica with no definite locality; and one in the collection of the M. C. Z., obtained from the U. S. Nat. Mus. in exchange. In my collection, or in that made by Mr. A. E. Wight, not a single example occurs. In my notebook I find record of catching what I took to be *Anolis sagrae* at Anotto Bay, but the specimen is evidently lost. In coloration I do not believe that this lizard can be distinguished from *A. lineatopus*, but the larger head shields, the more even sized and more strongly keeled ventrals serve to separate specimens in hand easily. A comparison of the four specimens with Cuban and Bahaman specimens shows no difference between them.

This lizard ranges through the Bahamas to Cuba, Jamaica, and part of Central America also; according to Boulenger, to Venezuela.

Anolis iodurus GOSSE.

Gosse, *Ann. Mag. Nat. Hist.*, 1850, ser. 2, 6, p. 344.

Dr. Stejneger, who has very kindly aided me in the study of these lizards, has shown me that the species usually called *A. grahamii* Gray has been confounded with *A. iodurus*. Gosse states that the ventral scales are smooth, while Gray states that in his species the ventrals are keeled. This species is the vivid green species with sky-blue tail which is found about Kingston and other localities in middle Jamaica, as in Hope and Castleton Gardens, at Anotto Bay and about Spanish Town and Bog Walk. The dewlap is very widely distensible and is a burnt orange color with a deeper red center. It changes to brown or almost black, and when it does so, faint vermiculations appear like those which so strongly mark *A. opalinus* and the true *A. grahamii*. Usually, however, it is solid leaf green and is, in life, very easily distinguishable from these other two species. In the young there is often a wide white vertebral band, and this is sometimes visible in examples about half grown. In three specimens from Mandeville there is a strong tendency toward an imbrication of the smooth ventrals; this is also marked in some of the series of about twenty from Kingston; it is more or less evident in all.

Confined to Jamaica.

Anolis opalinus Gosse.

Gosse, Ann. Mag. Nat. Hist. 1850, ser. 2, 6, p. 345.

This species is apparently confined to the western part of the island. The United States National Museum has two specimens from Moneague. Gosse's specimens came from about Bluefields. There are fifteen from Mandeville at hand. Stejneger felt some doubt as to whether these really represented Gosse's *A. opalinus* because of the small numbers in the collections. Gosse states that this and *A. iodurus* are the commonest lizards in the parishes of St. Elizabeth and Westmoreland. Now these parishes are not very thickly populated and contain no large towns, consequently I presume that the mongoose has had an even freer hand thereabouts than elsewhere. As for the abundance of the species under discussion about Mandeville, I can say that undoubtedly twenty-five specimens could be taken in any walk of a couple of hours, though it must be admitted that here again the lizards are rarer a little distance out of town than near it or even in the town itself.

This species is easily distinguished in life. The green phase does not show a solid color, but strong, well-marked vermiculations of a light color—almost white. Along each side there is generally a broad light band. In the brown condition the markings on the body are as evident; the tail is usually brown. The smooth plate-like ventral scales which show no tendency to imbricate and which are rather irregular in form and size, distinguish spirit specimens from *A. iodurus*. In life the almost always present white lateral stripe serves as a field mark for distinction from the solid green-bodied and sky-blue-tailed *A. iodurus*. In the former species the dewlap is different from that of the latter. It is pink with usually a light, almost white, edge.

Also confined to Jamaica.

Anolis grahamii GRAY.

Gray, Cat. Lizards Brit. Mus., 1845, p. 247.

Though in the field this lizard is practically impossible to distinguish from the preceding species of small green lizard, it is very easily separated when the specimen is in hand. The ventrals are inclined to imbricate and have a heavy swollen keel. At Bath, Port Antonio, and about Mandeville we took a considerable series of this species, and the variation in color was remarkable. Some were green with the tail hardly less blue than those so characteristic of *A. iodurus*, while others were dotted and marbled with the light color on a dark dull field identical with *A. opalinus*, except that the white lateral stripe was never a wide band but only suggested. This species represents beyond doubt what Cope (Proc. Acad. Nat. Sci., Phila., 1894) called *Anolis flabellatus*. Port Antonio was the type locality for this synonymous form. Generally speaking, this lizard seemed rarer than either of the former two.

Confined to Jamaica.

The name *Celestus* is used here for the three members of the Anguidae, each peculiar to Jamaica. The absence of an unguis into which the claws may be retracted is a character of generic value, as opposed to the presence of the sheath in the true *Diploglossi*.

The anguids of Jamaica have been described under a number of names, each purporting to represent a distinct species. In the pages that follow, their number has been reduced to three. It is extremely improbable that there are more forms than this in an area the size of Jamaica. They probably at one time occurred all over the island, though they are now, owing to mongoose ravages, of sparse occurrence in highlands only. The occurrence of all three species in Mandeville is good proof that there was never any localized distribution for *Celesti* such as now exists among the Anoles.

To find the former in any numbers it is necessary to get a number of men at work moving all possible loose stones. Pulling down stone walls is a very probable means of finding them. They are quick in trying to escape, and when taken in the hand they bite fiercely and struggle so that it is difficult to keep the tail and squamation undamaged. An open, wide-mouthed bottle of spirits should be immediately at hand.

The following quotation from page 77 of the "Naturalist's Sojourn in Jamaica" is all Gosse has to say of *Celestus*. "In the swamps and morasses of Westmoreland, the yellow Galliwasp (*Celestus occiduus*), so much dreaded and abhorred, yet without reason, might be observed sitting idly in the mouth of its burrow, or feeding on the wild fruits and marshy plants which constitute its food." From the stomach of one of this genus isopods and cockroaches were taken and also what I took to be remains of freshly devoured earthworms.

Celestus occiduus (SHAW).

Lacerta occidua Shaw, Zoology, 1802, 3, p. 288.

Diploglossus occiduus Shaw, Boulenger, Cat. Lizards Brit. Mus., 1885, 2, p. 290.

D. striatus Gray, Boulenger, Cat. Lizards Brit. Mus., 1885, 2, p. 289.

D. hewardii Gray, Boulenger, Cat. Lizards Brit. Mus., 1885, 2, p. 291, pl. 17.

There can be, I think, no doubt whatever that the species Shaw described is a rather variable one characterized by its scales being both keeled and striate, which must include the other species mentioned above. Three specimens taken in Mandeville, Jamaica, show that size is valueless as a means of separation. Scale rows then vary from 40 to 56, and the colorations include the phases which Boulenger has described for his three separate species, and one remains to be added, viz., rich red brown, with longitudinal black comma-like marks on the back, and white spots on the sides. Sides of neck black; the black area divided into squares by white lines.

This, the largest and most conspicuous member of the genus in Jamaica, has been the one which heretofore has come most often to herpetological collections. It is now, however, very rare, the mongoose being without doubt responsible for its reduction in numbers.

Celestus cruscus (GARMAN).

Diploglossus cruscus Garman, Bull. Essex Inst., 1887, 19, p. 22.

Diploglossus bakeri Boulenger, Ann. Mag. Nat. Hist., 1900, ser. 7, 6, p. 193.

This, the *Celestus* with striate but non-carinate scales, is less common about Mandeville, Jamaica, than the smooth-scaled *C. impressus*, and more abundant than the keeled-scaled *C. occiduus*. With Garman's type from Kingston (M. C. Z., No. 6051) before me, there is no doubt that *D. bakeri* Boulenger is identical. The color of the type is now somewhat faded, but it is evident that originally it agreed exactly with the color Boulenger has so accurately described. Six specimens which I procured near Mandeville and three which Mr. Wight has sent in also agree with Boulenger's description. In these fresh specimens the bellies of the males are a brilliant salmon pink. The scale rows are variable in number; records give from 38 to 50.

Celestus impressus COPE.

Cope, Proc. Acad. Nat. Sci. Phila., 1868, p. 127.

This is the most common member of the genus about Mandeville, Jamaica. I obtained twenty-one specimens, and Mr. A. E. Wight two. The scales are smooth. Cope's type was undoubtedly a dried and shrunken specimen. This accounts for the "dorsals with a cross elevation and marginal depression making rows of pits." The narrow brown bars, from eighteen to twenty in number, which are broken and alternate at the median line, serve to distinguish this from the other two Jamaican species of *Celestus*. The type of *Celestus maculatus* (Garman) from Cayman Brac (M. C. Z., No. 6231), is closely related to this species. It is, I think, undoubtedly distinct and can be distinguished by the broad dark lateral band running through the eye along the side to the hind limb. The coloration of the twenty-three Jamaican examples studied is typical and unvarying.

Ameiva dorsalis GRAY.

Gray, Ann. Nat. Hist., 1838, 1, p. 277.

Gosse, Nat. Sojourn in Jamaica, 1851, p. 74.

Perhaps no lizard in Jamaica has suffered more from the ravages of the mongoose than this one has. Dr. J. E. Duerden wrote in the Daily Gleaner of 1896, that it had been almost exterminated but was beginning to reappear more commonly near the town. Now, while this lizard is an especially shy one, it seems fairly common in hot sunny pasture lots near the city of Kingston. It has probably grown more common as the mongoose has grown scarce, owing to the latter's being frequently killed in thickly settled communities, where it is a great robber of hen roosts. This lizard was reported by Gosse as very abundant. It is known to the natives by the name of "ground lizard" in most localities where open cleared land occurs extensively. We did not succeed, however, in obtaining specimens anywhere but about Kingston, where we took twelve.

It is known only from Jamaica.

Mabuia sloanii (DAUDIN).*Scincus sloanii* Daudin, Reptiles, 1804, 4, p. 287, pl. 55, fig. 2.*Mabouya agilis* Gosse, Nat. Sojourn in Jamaica, 1851, p. 75.

This little skink, which is known to the negroes by the quaint name of "snake-waiting boy," is now one of the rarer members of the island fauna. Along with the other ground-inhabiting creatures of the lowlands near the coast this has been preyed upon extensively by the mongoose. About Kingston we procured three examples, and these were the only ones seen during our stay on the island. They seem to replace the so-called "galliwasps" (Celesti) in the lowland areas. Indeed, the negroes about Kingston have noticed this, and I was told that in the vicinity of the town there were no "galliwasps," while in the highlands, where they were found, one did not get the skink. The native name is given them because of the supposition that they follow snakes, as the jackal is often spoken of as the lion's follower.

Gosse reports the species as abundant, while Duerden in the Gleaner wrote, "Now occasionally found about Kingston."

Boulenger has tersely stated the distribution of this form as "West Indies south of 20°." This area, however, includes the ranges of several distinct but imperfectly known species. This form is doubtless confined to Jamaica.

Typhlops lumbricalis (LINNÉ).*Anquis lumbricalis* Linné, Syst. Nat., ed. 10, 1758, 1, p. 228.*Typhlops lumbricalis* Gosse, Nat. Sojourn in Jamaica, 1851, p. 262-267.

This species is one spread generally over the island, though owing to its burrowing habits it is not often seen except by lifting rocks. Nearly all of the fifteen examples we took were under stones at Bath, Mandeville, and near Kingston. Mr. A. E. Wight has sent eight specimens, all from near the mouth of Bog River, in the vicinity of Port Antonio, northeast Jamaica. His field notes show that he caught one of these just as it was crawling into an old stone wall. Gosse records finding the eggs in the nests of Termites, a habit, then, which this species has in common with a number of African congeners.

Its range geographically extends from Abaco Island in the northern Bahamas, through the Antillean groups to British Guiana.

Tropidophis maculata (BIBRON).*Leionotus maculatus* Bibron, Sagra's Hist. Cuba, Reptiles, 1843, p. 212, pl. 24.*Leionotus maculatus* Gosse, Nat. Sojourn in Jamaica, 1851, p. 324-325.

A single typical example taken near Kingston is the only specimen of this species which is at hand. As Boulenger's descriptions (Cat. Snakes Brit. Mus., 1893, 1, p. 112, 113) show, this form, the only one known from Jamaica, is easily distinguished from the Cuban (*T. pardalis* Gundlach) by having a larger number of ventrals. The coloration is variable enough in *T. pardalis* (Gund) to bring it very close to that of *T. maculata* (Bibr.).

The single specimen was found tightly coiled up under a flat rock. Nothing notable is known of its habits.

In this genus material is insufficient to define the range of this form.

***Epicrates subflavus* STEJNEGER.**

Stejneger, Proc. U. S. Nat. Mus., 1901, **23**, p. 469-470.

The Jamaica boa is so nearly extinct that it is now rarely captured. It still exists, I am told, on Goat Island off the southern coast of Jamaica in considerable abundance. There are no specimens in the collection here, though the United States National Museum in Washington possesses several examples.

The species, recently separated from *E. inornatus* Reinhardt, has been fully discussed in connection with the original description.

***Leimadophis ater* (GOSSE).**

Natrix atra Gosse, Nat. Sojourn in Jamaica, 1851, p. 228.

Dromicus ater Boulenger, Cat. Snakes Brit. Mus., 1894, **2**, p. 121.

The name *Leimadophis* (Fitzinger, 1843) is used for this and the following Jamaican snake, according to the distinction which Stejneger (Herpt. of Porto Rico, 1904, p. 694-695) has drawn between the two genera of coronelline snakes occurring in Porto Rico. The other genus, *Alsophis* (Fitzinger, 1843), is not found in Jamaica.

The absence of distinct pairs of pores near the apices of the dorsal scales fixes these two forms in this genus. This species may be easily distinguished by the absence of loreal shield and the following scale count: scales in 17 rows; ventrals 170-185; subcaudals 144-162. Compare these counts with those given for *L. callilaemus* (Gosse).

It is now extremely rare, and not a single example was taken. In the collection there are three (Mus. Comp. Zool., Nos. 6007, 1 ex.; 6005, 2 ex.), all from near Kingston. James Gall collector. The National Museum in Washington has four, Nos. 7375, 7332, 12364, labeled Jamaica; No. 5093 is marked "Cuba," but was taken by Mr. C. Wright, who collected in Jamaica. It is typical of this species, and without doubt the label is wrongly marked.

Confined to the island.

***Leimadophis callilaemus* (GOSSE).**

Natrix callilaema Gosse, Nat. Sojourn in Jamaica, 1851, p. 384-385.

Liophis callilaemus Boulenger, Cat. Snakes Brit. Mus., 1894, **2**, p. 142-143.

This species may be distinguished from the one previously mentioned by the following characters. A smaller adult size, the presence of a small square loreal shield, and the following scale formula: scale rows 17 or 19 (regularly the latter); ventrals 130-151, subcaudals 170-110. This form, which previously has seemed far rarer in collections than *L. ater*, is now not uncommon in some localities. The writer took fourteen near Kingston, and Mr. Wight has collected

two in Mandeville and three in Port Antonio. From the two latter stations the specimens are olive or dark brown, the markings rather indistinct. All the Kingston specimens are red when adult with scattered marks on the sides of the head and throat. The young have a blackish stripe along the body and are spotted with dark brown. The throat and head are heavily marked with brown. The ground color, however, is the same as in the full-grown examples, viz., brick red.

Also confined to Jamaica.

***Pseudemys palustris* (GMELIN).**

Testudo palustris Gmelin, Syst. Nat., 1788, 1, part 3, p. 1041.

Stejneger, Rept. U. S. Nat. Mus. for 1902, 1904, p. 710-714.

Unfortunately only a single example from this island, which is the type locality, has come to hand. It was taken near Port Antonio, Jamaica. So poorly preserved that none of the markings on the head or limbs are distinctly visible, it does not throw any light on the possible existence of local races of this species on the different islands. I agree with Dr. Stejneger in anticipating these.

Turtles were seen in small ponds in various parts of the island, but they were so excessively shy that it was impossible to catch any.

Known from Jamaica, Haiti, Porto Rico, and Cuba.

***Crocodylus americanus* LAUR.**

Laurenti, Syn. Rept., 1768, p. 54.

Boulenger, Cat. Chelonians, etc., Brit. Mus., 1889, p. 281.

Crocodyles, hideously stuffed, are offered as souvenirs to tourists in the "curiosity shops" of Kingston. They seem to represent this species only. The natives state that there are still a number of localities about the island where crocodiles are abundant. All agree that they may be taken at the mouth of Milk and Black Rivers and in many other less important creeks emptying to the south and east. There are five small specimens in the collection of this Museum, taken many years ago near Kingston.

Ranges over Pacific coast region of Ecuador; Central America, Mexico, Cuba, Jamaica, and Florida.